UNDERSTANDING INTRAAORTIC BALLOON PUMPING

Peter A Lewis BN RM CertCC MNed PhD cand.

Introduction

Intraaortic balloon pumping (IABP) is an established treatment for the support of a failing heart (Christenson, Simonet et al. 1997). It is a process undertaken in most level two and three intensive care units. Despite IABP appearing complex, the principles are straightforward. A sausage shaped intraaortic balloon (IAB) about 250 millimetres long and 15 millimetres in diameter, is placed in the descending aorta and attached to an external pump. The external pump then inflates and deflates the IAB in synchrony with cardiac contraction. The primary purpose of this is the support of a compromised heart with a simultaneous increase in myocardial oxygen supply, and decrease in myocardial oxygen demand (Overwalder, 1999). As a nurse it is worthwhile understanding the principles of IABP. As a hospital intervention, it's exposure to nursing is high.

Physiology

The IAB is inflated at the onset of diastole when blood ceases to eject from the heart. Inflation of the IAB results in displacement of blood volume within the descending thoracic aorta. Proximal blood is returned to the heart to oxygenate the coronary arteries while blood in the distal descending aorta is circulated around the body. IAB deflation, however, is timed to occur immediately prior to the onset of systole before the heart commences ejection. This ensures afterload is reduced and blood is ejected into a partially empty aorta. Cardiac

workload and the consequent demand for oxygen can thus be reduced. This reduction in afterload also improves cardiac output and increases systemic perfusion (Overwalder, 1999).

Primarily IABP increases myocardial oxygen supply and decreases myocardial oxygen demand. Secondarily IABP improves cardiac output, increases coronary perfusion pressures, increases systemic perfusion, reduces mitral regurgitation and reduces afterload which will subsequently decrease left ventricular workload (Bolooki 1989; Overwalder 1999).

Mechanics

The adult IAB is available in three sizes: 34 millilitre balloon volume; 40 millilitre balloon volume; and 50 millilitre balloon volume (Krau, 1999). When the IAB is inflated it has a diameter of 15 millimetres (Datascope 2002). IABP requires the positioning of an IAB in the descending thoracic aorta (see figure 1). The IAB is located immediately inferior to the origin of the left subclavian artery and superior to the renal arteries (Overwalder, 1999). The IAB is then attached to an external pump used to inflate and deflate the IAB in synchrony with cardiac contractions (Overwalder, 1999).

Historical background

Diastolic augmentation to assist in the treatment of left ventricular failure was described for the first time in 1958 (Harken, 1958). Harken suggested that the removal of blood from the femoral artery during systole and it's rapid replacement during diastole would both assist cardiac output and unload the

heart simultaneously (Harken, 1958, 1976). Considering these principles an IAB prototype was developed in 1962 and integrated into client care in 1968 (Kantrowitz, Tjonneland, & Freed, 1968; Moulopoulos, Topaz, & Kolff, 1962). This experience was mixed, demonstrating an improvement in haemodynamic function but no significant alteration in mortality rate.

IAB development has continued since 1962 and practice has consequently changed dramatically. Technological advance has allowed easier IAB insertion, the provision of a smaller IAB and a more efficient external pump. Greater circulatory benefits and fewer complications are the result. Time has also seen the change in IABP indications.

Indications

Accepted guidelines for IABP include: cardiogenic shock; left ventricular failure; stunned myocardium; myocardial contusion; unstable angina; failure to separate from cardiopulmonary bypass; procedural support during coronary angiography and angioplasty; bridging to heart transplantation; septic shock; drug induced cardiovascular failure; and prophylactic application in the event of preoperative surgery especially cardiac surgery or myocardial infarction (Overwalder, 1999). IABP has also been used successfully in the treatment of clients to augment cerebral blood flow in the setting of cerebral vasospasm, in the anaesthetic management of high risk cardiac clients undergoing non cardiac surgery and for the management of myocardial failure after severe post partum haemorrhage (Apostolides, Greene, Zabramski, Fitzgerald, & Spetzler, 1996; Masaki et al., 1999; Mayr et al., 1999; Nussbaum et al., 1995; Nussbaum,

Sebring, Ganz, & Madison, 1998; Rosen, Sekhar, Duong, Seifert, & Persson, 2000; Sanborn et al., 2000).

Complications

IABP is not without risk. Over recent times technological advance has been responsible for a dramatic decrease in complication rates. Despite these advances, complications remain numerous. These include: limb ischaemia; platelet activation; thromboembolism; aortic dissection; infection; IAB rupture; IAB entrapment; and vascular injury – false aneurism at the catheter insertion site, arterial perforation, and renal or abdominal organ dysfunction (Haas Stavarski, 1996; Shin, Yozu, Sumida, & Kawada, 2000; Vonderheide, Thadhani, & Kuter, 1998).

Nursing care of the IABP patient

Principles of IABP may be reasonably simple, however, nursing care of a patient subject to this intervention can be a complex task. While care of the IABP creates a new nursing challenge it is the secondary problem of heart failure which complicates care. Inadequate heart function will compromise any bodily system reliant on adequate cardiac function. The impairment of the hearts ability to pump causes a decrease in blood pressure and the consequent onset of shock. The complications of shock are those which complicate nursing care. The patient is often mechanically ventilated, is almost certain to be receiving a medley of pharmacological support (e.g. inotropes to support the heart such as adrenaline; vasopressors to support the blood pressure and peripheral perfusion such as GTN; diuretics to prevent renal failure such as

frusemide) and will be restricted to bed rest as a consequence of the IABP. The nurse is required to combine vigilance with careful and methodical assessment skills to care for this patient adequately.

In caring for patients receiving IABP the nurse must make sound clinical assessments and ensure accurate and consistent observations. Assessments and observations which must be undertaken are those specific to cardiac function, the IABP process and possible IABP complications. Assessments include: blood pressure; heart rate; urine output; mentation; peripheral perfusion; lung function; and fluid replacement requirements. Blood should be drawn regularly to monitor electrolytes and clotting. Hourly documentation of these assessments provides a picture as to how the patient is progressing informing future patient cares. Documentation in addition to assessments should include the function of the external pump (the frequency which it inflates the IAB, and the augmentation it provides the IAB and systolic blood pressure) and dosage of any pharmacological interventions.

While specific skills are required to care for the IABP, the ventilator, multiple infusions and drains, the nurse must not lose sight of the human element of nursing. The nurse should not merely care and tend the interventions and procedures but also care and tend the patient. A patient must have confidence in the nurse, must trust and feel reassured by the nurse and must be continually educated by the nurse. This nurse/patient partnership which is so evident in general nursing must not be lost as the complexity of care increases.

Summary

It remains the responsibility of any nurse to assume accountability for their cares. Understanding the physiology and process behind any intervention improves patient cares while also increasing nursing satisfaction and skill. IABP is no exception. An awareness of IABP will facilitate sound nursing care, ensure early identification of possible complications or patient compromise, and warrant patient and relative satisfaction. It will also assist in the transition of caring for a patient subject to this 'complex' medical intervention.

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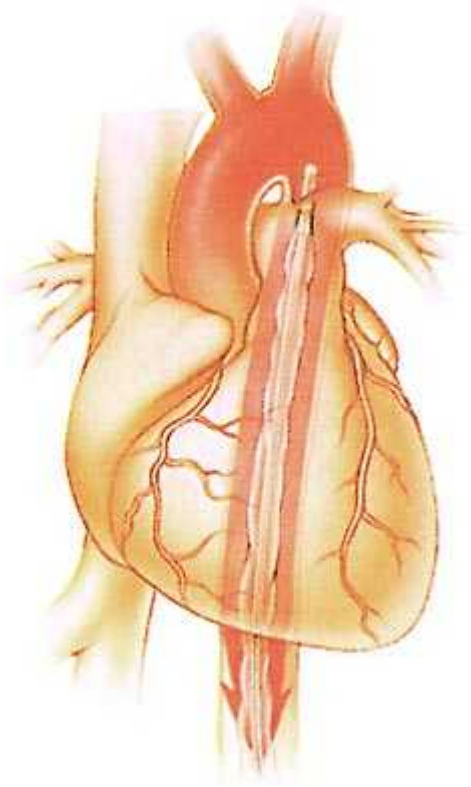

Figure 1. Location of the intraaortic balloon (in this figure the intraaortic balloon is deflated).

This figure has been downloaded from the web. If there are copyright issues I am able to draw a diagram similarly depicting IABP.

Despite the complexity of any situation the process of nursing care should remain the same. Good nursing is based around sound assessment skills (on which future interventions will be based), accurate and consistent observations (which demonstrate stability of the patient condition) and a desire to do what is in the patients best interest (problem rectification will not necessarily heal a patient).

Peter Lewis
Lecturer, Christchurch Polytechnic Institute of Technology
PO Box 540
Christhchurch
New Zealand 8015
Phone 03 940 8074 (ext. 8289)
Email: lewisp@cpit.ac.nz

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Anne Manchester
Co-editor Kai Taiki Nursing New Zealand
Level 3, Willbank Court
57 Willis Street
P O Box 2128
Wellington
New Zealand

Dear Ms Manchester

I have attached a submission to *Kai Tiaki Nursing New Zealand* entitled "Understanding Intraaortic Balloon Pumping." The manuscript is seven pages in length including two pages for references and a single page for the one figure.

I am reaching the end of my PhD on intraaortic balloon pumping and thought this brief summary of the processes behind balloon pumping, may be of interest to your readers.

Thankyou for your consideration,
Sincerely

Peter Lewis BN RM CertCC MNed PhD cand.